SFA

Corporate Office

FINAL REPORT

Engineering Design, Construction, Operation, and Maintenance of the 7-Ohm Line and Relativistic Klystron Facilities

SFA, Inc. ■ 1401 McCormick Drive ■ Landover, Maryland 20785-5322 ■ Tel. (301) 925-9400 ■ Fax (301) 925-8612

SECURITY CLASSIFICATION: Unclassified

SFA--93/004

Engineering Design, Construction, Operation, and Maintenance for the 7-Ohm Line and Relativistic Klystron Facilities

Prepared by: Mariano Sy and Kevin Smith

SFA, Inc.
1401 McCormick Drive
Landover, Maryland 20785

Date: September 1993

Contract Number: N00014-89-C-2042

Prepared for: Naval Research Laboratory
4555 Overlook Avenue, SW
Washington, DC 20375-5000

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (*Leave Blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1993	Final Report 10/26/88 to 07/24/93

4. TITLE AND SUBTITLE

Engineering Design, Construction, Operation, and Maintenance for the 7-Ohm Line and Relativistic Klystron Facilities

5. FUNDING NUMBERS

N00014-89-C-2042

6. AUTHOR(S)

Mariano Sy and Kevin Smith

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

SFA, Inc.
1401 McCormick Drive
Landover, MD 20785

8. PERFORMING ORGANIZATION REPORT NUMBER

SFA--93/004

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Naval Research Laboratory
4555 Overlook Ave., SW
Washington, DC 20375-5000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

13. ABSTRACT (*Maximum 200 words*)

SFA designed, built, installed, operated, and maintained special-purpose equipment and fixtures in support of experimental research in high-power RF radiation and particle acceleration. Specifically, SFA personnel designed and fabricated hardware for experimental application of the 7-Ohm line generator; modulated intense relativistic electron beams (IREBs); constructed magnetic field coils and low-voltage, high-energy capacitor banks; upgraded the relativistic klystron facility; and designed and fabricated a relativistic klystron amplifier.

14. SUBJECT TERMS

15. NUMBER OF PAGES
21 pages

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

Under contract N00014-89-C-2042, SFA designed, built, installed, operated, and maintained special-purpose equipment and fixtures in support of experimental research in high-power RF radiation and particle acceleration. Specifically, SFA personnel worked on the following tasks:

- Design and Fabrication of Hardware for Experimental Application of the 7-Ohm Line Generator
- Modulation of Intense Relativistic Electron Beams (IREBs)
- Construction of Magnetic Field Coils and Low-Voltage, High-Energy Capacitor Banks
- Upgrade of the Relativistic Klystron Facility
- Design and Fabrication of Relativistic Klystron Amplifier

Design and Fabrication of Hardware for Experimental Application of the 7-Ohm Line Generator

SFA designed and built new hardware to apply the 7-ohm line generator to different experiments. This generator is a high-voltage machine constructed out of a 700 kV Marx generator, a pulse-forming line, and a high-voltage diode. The generator is constantly changed to match different experimental requirements. SFA personnel performed mechanical tasks related to the preparation, maintenance, and operation of this high-voltage machine. SFA planned, installed, and removed the scientific devices used as support equipment in the experimental area, and assisted in the assembly, rigging, and repair of devices used in the various experiments. SFA personnel maintained the vacuum pumps and oil and water systems. SFA also performed general maintenance on the 700 kV Marx generator, which included periodically cleaning the Marx column and triggering system. Other duties included routinely cleaning the high-voltage diode and pulse line, maintaining the vacuum system, and fabricating carbon cathodes and stainless steel cathode stocks.

Modulation of Intense Relativistic Electron Beams

To modulate the intense relativistic electron beams (IREBs), SFA designed and built structures consisting of coaxial cavities, which were pumped to a pressure of 10^{-5} Torr and maintained in close tolerance. The structures were machined out of stainless steel, and the surfaces of the cavities were lined with a 1-millimeter layer of either copper or silver. The mechanical design of these structures required familiarity with microwave circuit design. SFA fabricated, assembled, and installed the coaxial cavities; solved problems within the system; and applied leak detection techniques. SFA personnel also performed calibration checks and adjustments on vacuum systems, and aligned the cavities.

Construction of Magnetic Field Coils and Low-Voltage, High-Energy Capacitor Banks

SFA personnel constructed magnetic field coils and low-voltage, high-energy capacitor banks. This work included making forms, made of a non-conducting material, on which magnetic wires were wound as a long or short solenoid. The magnetic field coil withstood a minimum magnetic force of 10 kg/cm^2 during a minimum operation of 100 ms. The coil was energized by a 20 kV capacitor bank operated by ignitrons. SFA's responsibilities included layout, materials flow and handling, assembly, cost reduction, problem solving, fabrication, and quality control. SFA also ensured that proper grounding techniques and safety methods for high-voltage equipment were followed.

Upgrade of the Relativistic Klystron Facility

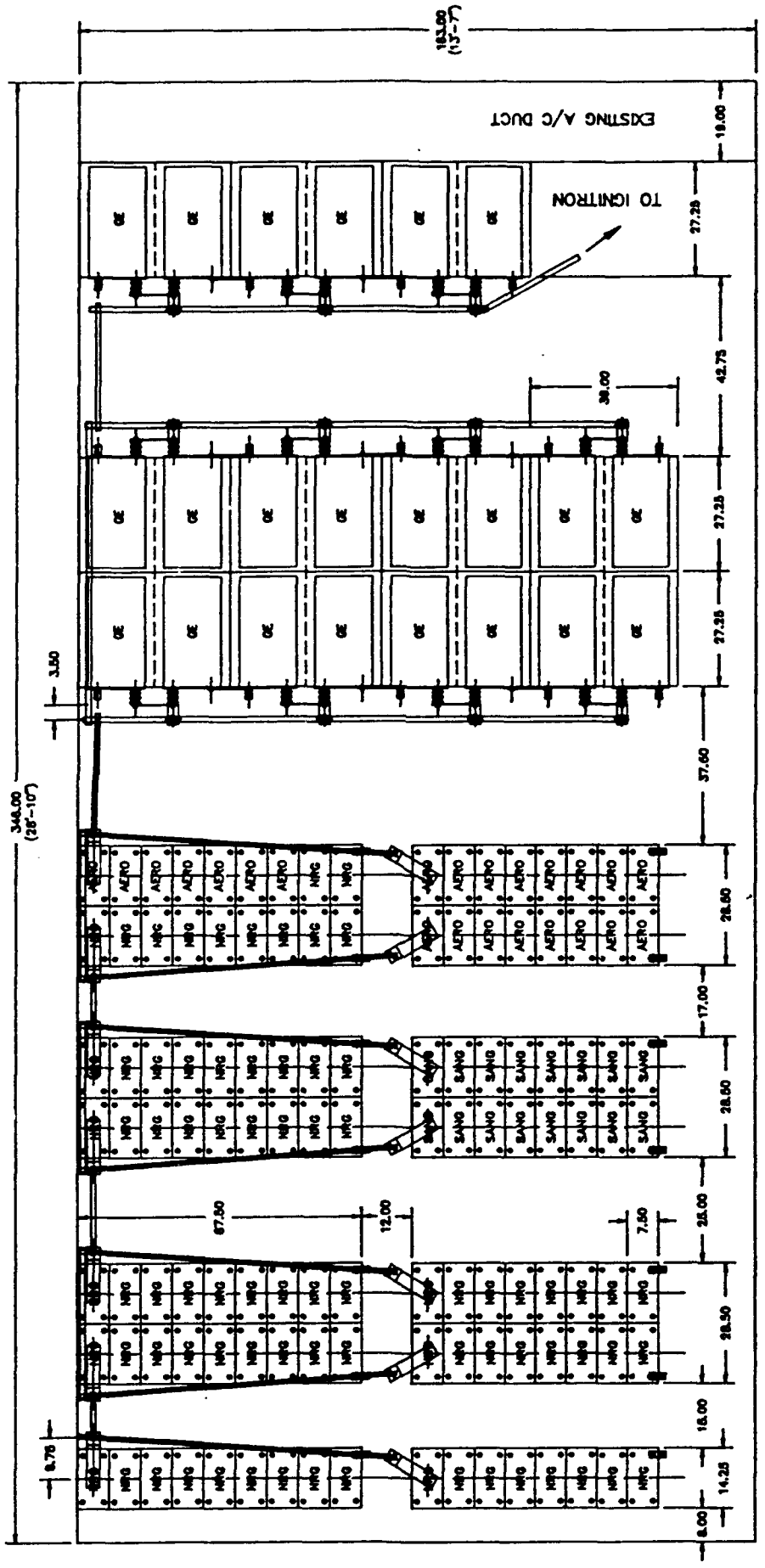
SFA personnel upgraded the relativistic klystron facility. SFA's responsibilities for this project included planning, construction, alteration, maintenance, setup, operation, and repair services for the facility's reconstruction. SFA managed the rigging subcontractor in the relocation of experimental components. In addition, SFA designed and installed acoustical partitions to buffer this high-noise facility from administrative support personnel. SFA installed capacitor banks, a Marx column, and a triggering system in the new Marx tank. SFA personnel constructed the pulse line and high-voltage diodes; installed the capacitor bank for low-voltage, high-energy magnetic-field coils; and installed a circulating water system and control panel for the pulse line and magnetic field coil. SFA also rewired the screen room for electronic equipment and installed a vacuum system for the high-voltage diode.

Design and Fabrication of Relativistic Klystron Amplifier

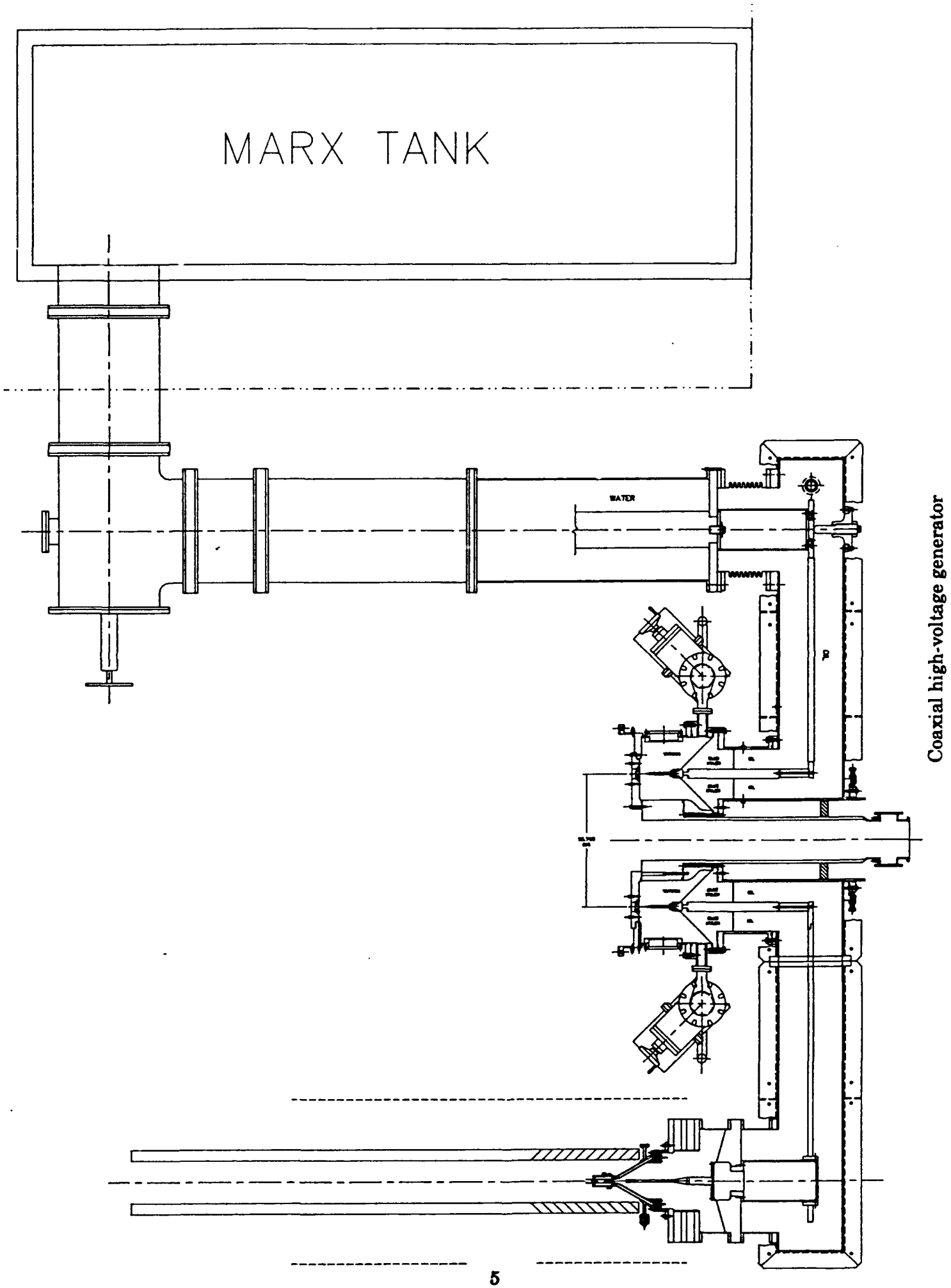
SFA designed and built a high-power relativistic klystron amplifier with a complete vacuum system (see Appendix). SFA personnel provided the engineering design and fabrication drawings for the coaxial high-voltage generator facility. SFA provided the layout of the floor plan for the new facility. SFA personnel laid out and installed 250 energy storage capacitors connected together with resistors, contact switches, and grounding systems. SFA personnel designed and prepared fabrication drawings of an oil tank and a high-voltage parallel transmission line to be connected to the existing 7-ohm Blumlein and Marx generator. SFA also designed and prepared fabrication drawings of the diode sub-assembly with a double insulator. Fabrication drawings were designed and prepared for a pumping ports housing with two ports connected to a diffusion pump, cold trap, and a mechanical gate valve through a pump adapter, with a third port connected to a large mechanical booster pump to increase vacuum pumping speed. SFA provided fabrication drawings for a viewing port housing with six rectangular ports, used for diagnostic testings and for access to the double insulator to clean carbon residue. SFA prepared fabrication drawings of the cathode sub-assembly and designed an end cover plate with test probes. Outer and inner magnetic field coils were designed. SFA personnel designed and prepared fabrication drawings for the cart to support the outer magnetic field coil. This cart can adjust the coil to its required height and position, and may move toward or away from the diode using dual roundway bearings that sit on tracks in the floor. SFA personnel performed the layout of the L-band waveguide transmission line to connect an existing magnetron located in an adjacent laboratory to the new facility. An L-band splitter was designed; the splitter, a waveguide switch, three isolators, and two bi-directional couplers were installed in the L-band waveguide transmission line. Radio frequency and microwave leak tests were performed on all joints after the system was installed.

APPENDIX

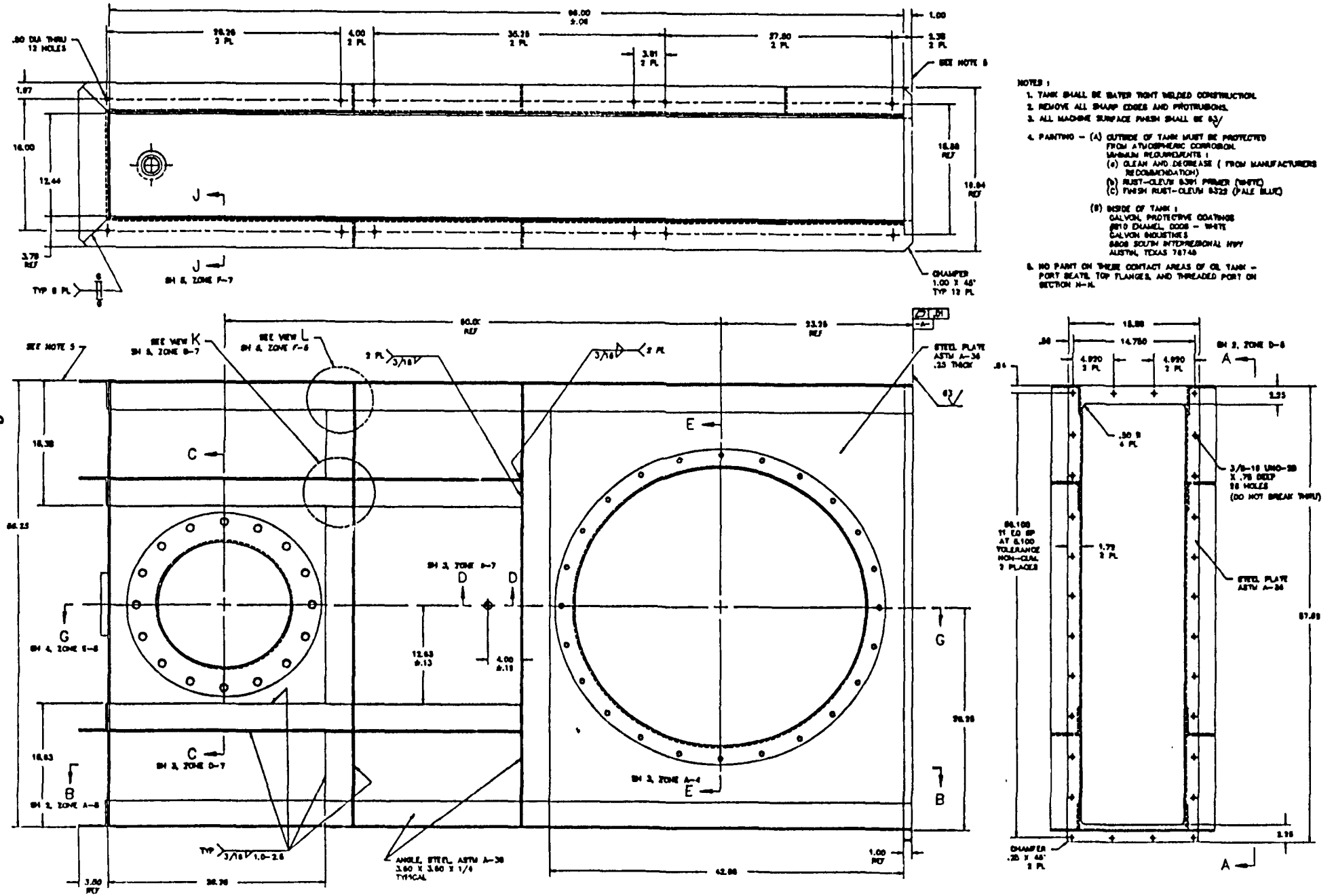
List of Figures



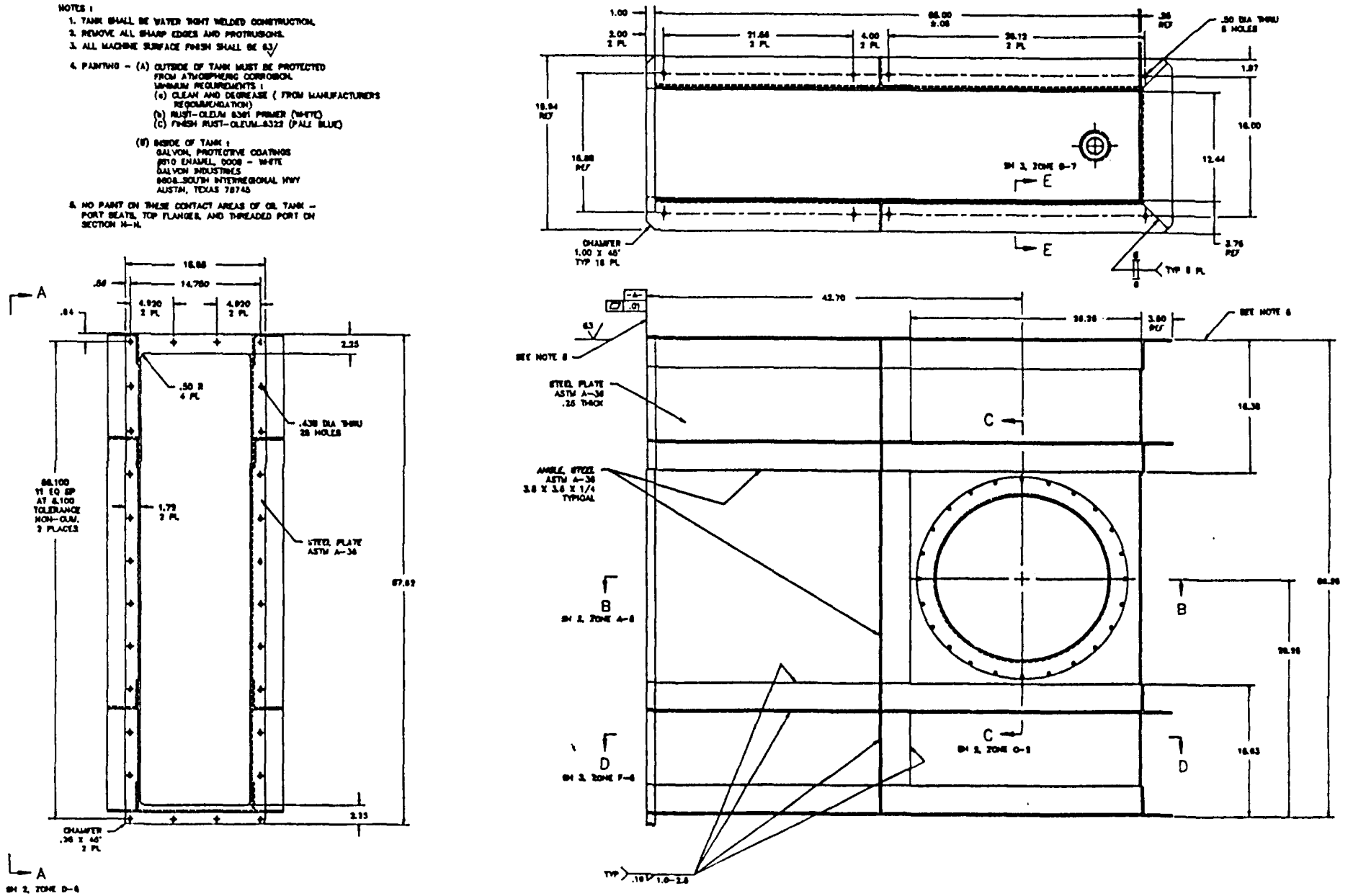
Capacitor layout, building 101, room 140



Coaxial high-voltage generator

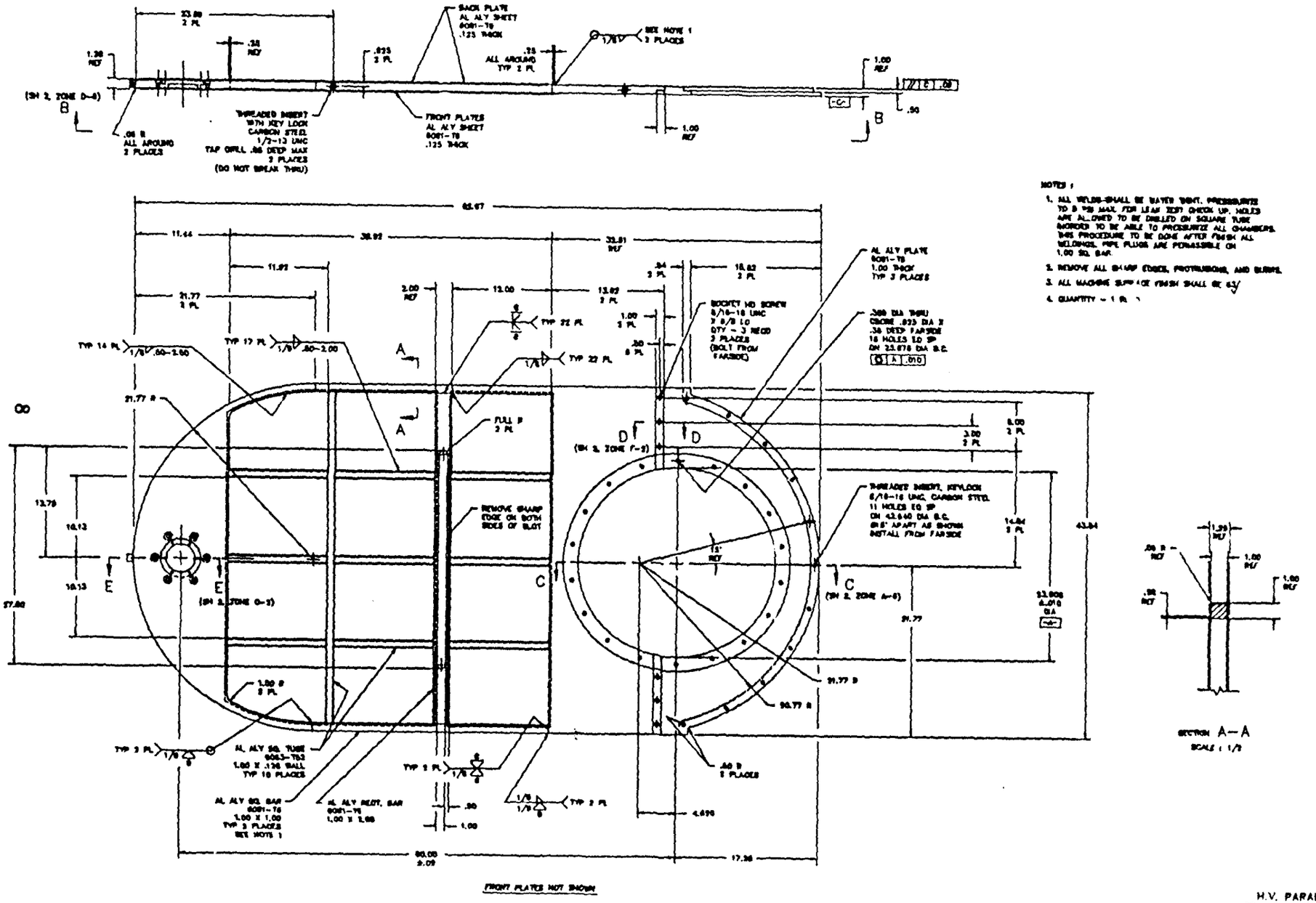

NOTES :
1. TANK SHALL BE WATER TIGHT WELDED CONSTRUCTION.
2. REMOVE ALL SHARP EDGES AND PROTRUSIONS.
3. ALL MACHINE SURFACE FINISH SHALL BE 63
4. PAINTING – (A) OUTSIDE OF TANK MUST BE PROTECTED FROM ATMOSPHERIC CORROSION.
MINIMUM REQUIREMENTS :
(a) CLEAN AND DEGREASE (FROM MANUFACTURERS RECOMMENDATION)
(b) RUST–OLEUM 6391 PRIMER (WHITE)
(c) FINISH RUST–OLEUM 6323 (PALE BLUE)
(B) INSIDE OF TANK :
CALVON PROTECTIVE COATINGS
#810 ENAMEL, DOOR – WHITE
CALVON INDUSTRIES
6808 SOUTH INTERREGIONAL HWY
AUSTIN, TEXAS 78746
5. NO PAINT ON THESE CONTACT AREAS OF OIL TANK – PORT SEATS, TOP FLANGES, AND THREADED PORT ON SECTION H–H.
SEE NOTE 5
SEE VIEW K
SEE VIEW L
STEEL PLATE ASTM A–36 .25 THICK
CHAMFER 1.00 X 45° TYP 12 PL
ANGLE, STEEL, ASTM A–36 3.50 X 3.50 X 1/4 TYPICAL
STEEL PLATE ASTM A–36
3/8–16 UNC–2B X .75 DEEP 16 HOLES (DO NOT BREAK THRU)

Oil tank

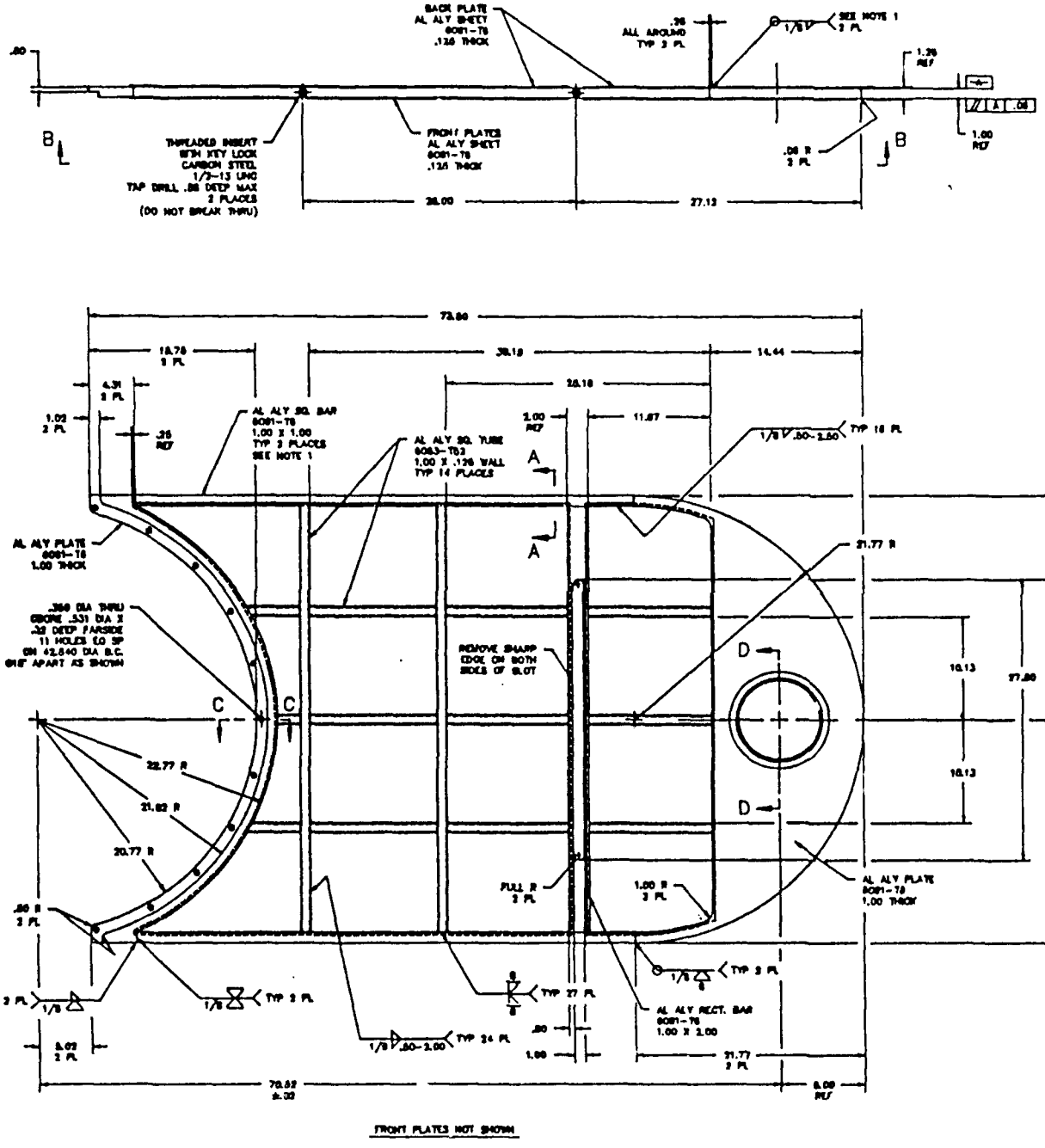


Oil tank, extension

OIL TANK, EXTENSION

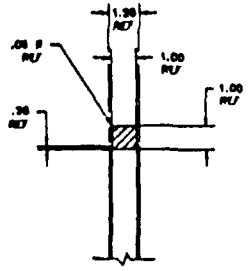


High-voltage parallel transmission line



NOTES :

1. ALL WELDS SHALL BE WATER TIGHT. PRESSURIZE TO 5 PSI MAX. FOR LEAK TEST CHECK UP. HOLES ARE ALLOWED TO BE DRILLED ON SQUARE TUBE SHOWDUR TO BE ABLE TO PRESSURIZE ALL CHAMBERS. THIS PROCEDURE TO BE DONE AFTER FINISH ALL WELDINGS. PIPE PLUGS ARE PERMISSIBLE ON 1.00 SQ. BAR.
2. REMOVE ALL SHARP EDGES, PROTRUSIONS, AND BURRS.
3. ALL MACHINE SURFACE FINISH SHALL BE 63
4. QUANTITY - 1 REQD

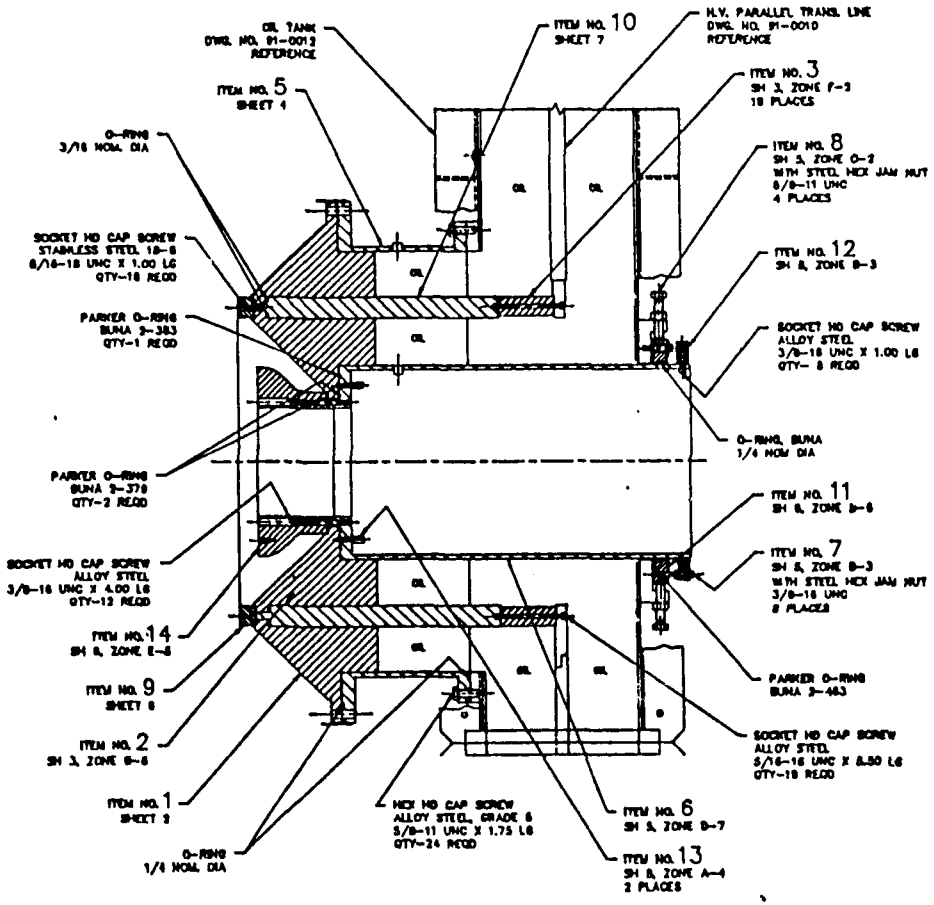


SECTION A-A
SCALE : 1/2

H.V. PARALLEL
TRANSMISSION LINE EXT.

91-0011

High-voltage parallel transmission line, extension



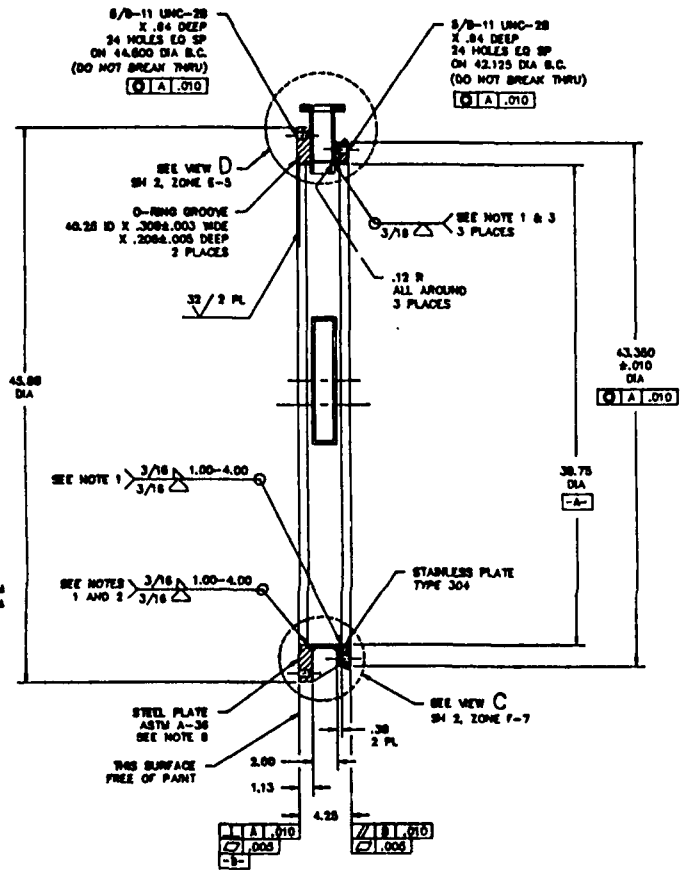
NOTES :

1. ALL WELDS SHALL BE WATER TIGHT.
2. REMOVE ALL SHARP EDGES AND PROTRUSIONS.
3. ALL MACHINE SURFACE FINISH SHALL BE 63
4. PAINTING :
   (A) OUTSIDE OF CYLINDER MUST BE PROTECTED FROM ATMOSPHERIC CORROSION.
   MINIMUM REQUIREMENTS :
   (a) CLEAN AND DEGREASE (FROM MANUFACTURERS RECOMMENDATION)
   (b) RUST-OLEUM 9391 PRIMER (WHITE)
   (c) FINISH RUST-OLEUM 8329 (PALE BLUE)
   (B) INSIDE CYLINDER :
   GAYLON, PROTECTIVE COATINGS
   #510 ENAMEL, CODE - WHITE
   GAYLON INDUSTRIES INC.
   8508 SOUTH INTERREGIONAL HWY
   AUSTIN, TEXAS 78748
   TEL # 512-282-1115
5. NO PAINT ON FLANGE CONTACT SURFACE.
6. ALL ITEMS HAVE TO BE PRE-ASSEMBLED TOGETHER AS SHOWN ON THIS DRAWING.
7. PROVIDE ALL SCREWS AND O-RINGS CALL OUT ON THE FIELD OF THIS DRAWING.

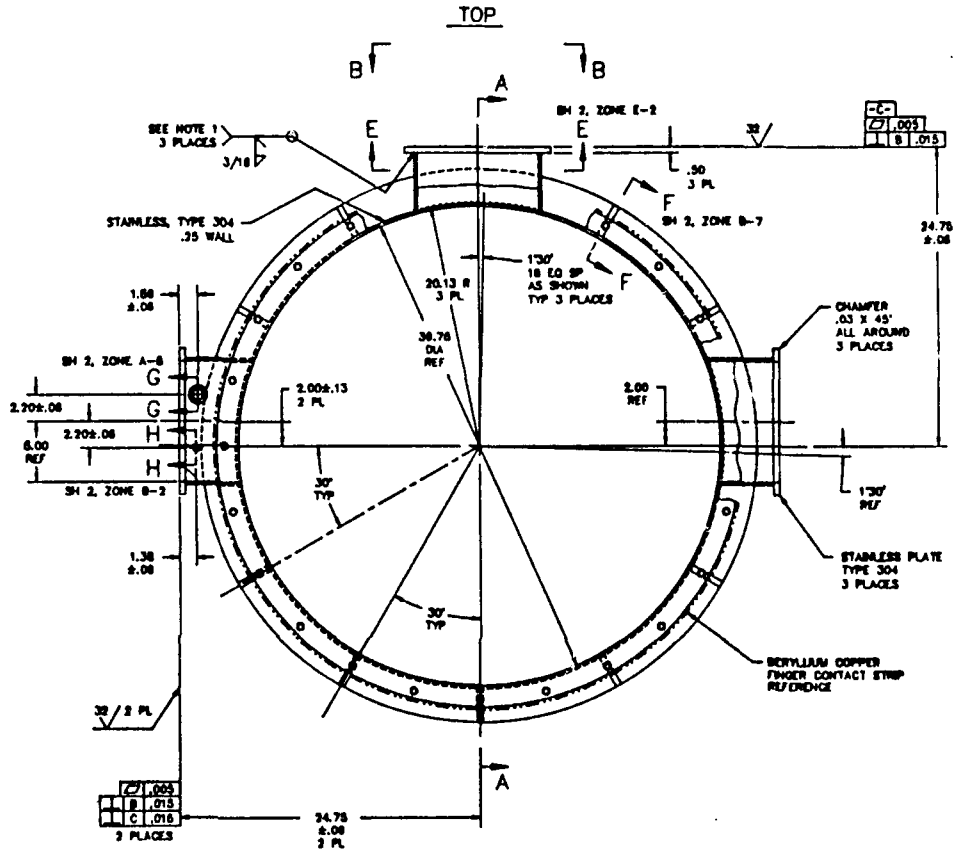
Coaxial high-voltage generator diode sub-assembly

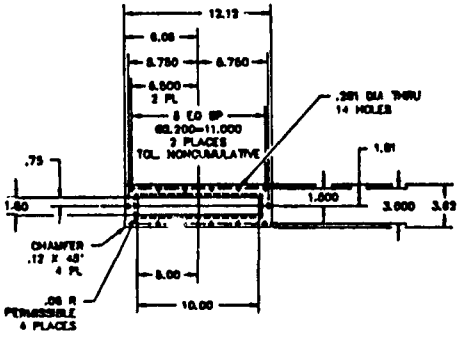
TOLERANCES	
DECIMALS	ANGLES
XX ±.02	±.010'
XXX ±.005	

COAXIAL H.V. GENERATOR DIODE SUB-ASSY	
	91-0021



SECTION A–A





VIEW B–B
3 PLACES
ONLY RECT. FLANGE IS SHOWN
ON THIS VIEW

NOTES :

1. ALL WELDS SHALL BE VACUUM TIGHT AND HAVE A HELIUM LEAK RATE OF 1×10^{-8} CC PER SECOND. VACUUM LEAK TEST IS REQUIRED, MINIMUM OF 10 TIMES PUMP DOWN, HOLD AND RELEASE, TO BE SURE WELDS ARE STRONG ENOUGH TO HOLD VACUUM.
2. USE APPROPRIATE PROCEDURE SPECIFIED ON ASM METAL HANDBOOK, WELDING AND BRAZING, FOR WELDING ASTM A-36 STEEL PLATE TO STAINLESS TUBE, TYPE 304.
3. INSERT ALL ROUND BARS, .125 DIA, AS SHOWN ON VIEW D, BEFORE WELDING THE FOUR PLATES OF RECTANGULAR PORT.
4. ALL MACHINE SURFACE FINISH SHALL BE 63√ OR BETTER.
5. QUANTITY – 1 REQD
6. BREAK OFF ALL SHARP EDGES AND CORNERS.
7. PARTS SHALL BE FREE OF DIRT AND GREASE.
8. PAINT ALL EXTERIOR SURFACE OF CARBON STEEL FLANGE :
   a. CLEAN AND DEGREASE.
   b. RUST-OLEUM 9391 PRIMER (WHITE)
   c. FINISH RUST-OLEUM 9322 (PALE BLUE)

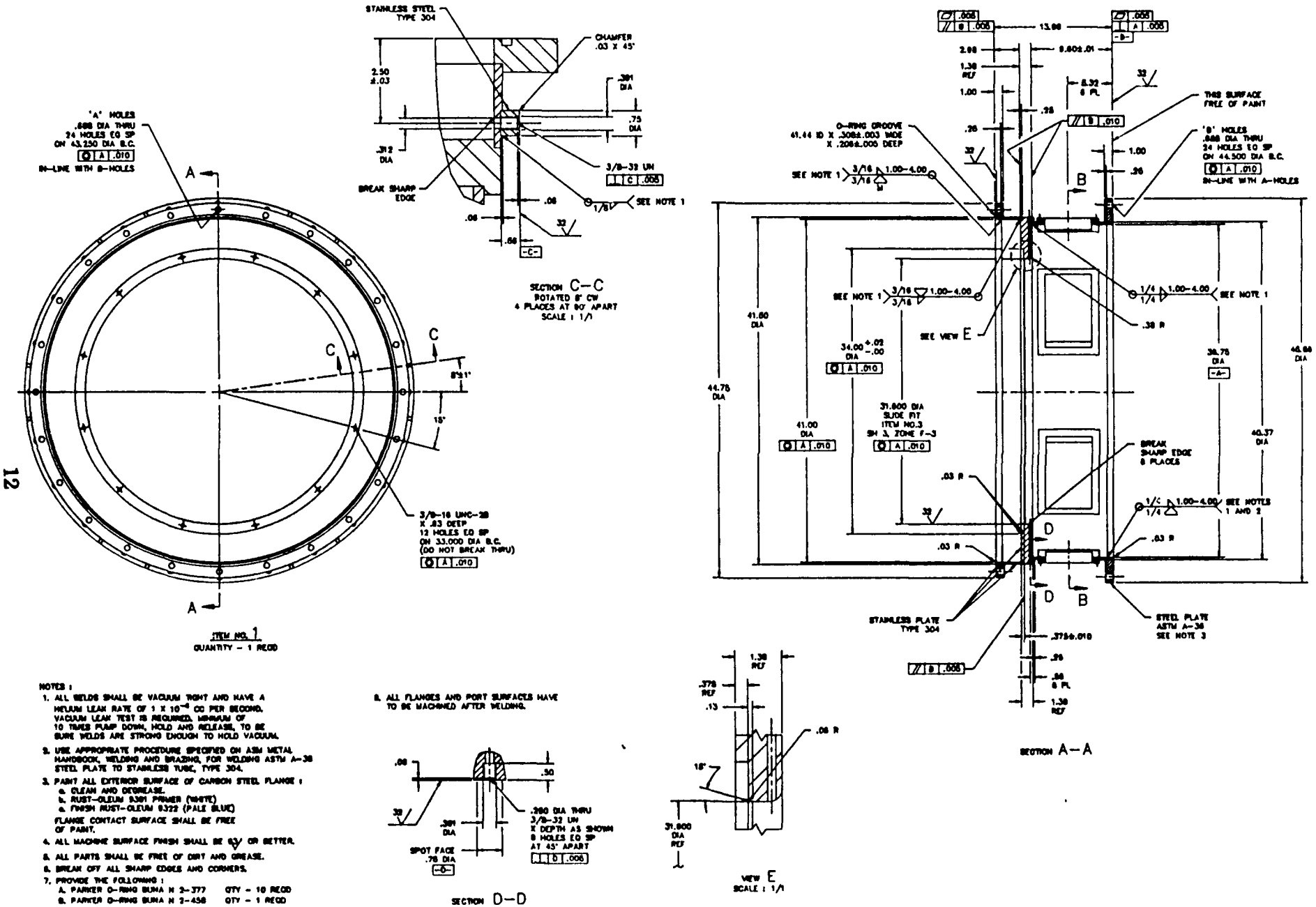
   FLANGE CONTACT SURFACE SHALL BE FREE OF PAINT.
9. ALL FLANGES AND PORT SURFACES HAVE TO BE MACHINED AFTER WELDING.

PUMPING PORTS HOUSING
COAXIAL H.V. GENERATOR

91-0027

11

Pumping ports housing



NOTES :

1. ALL WELDS SHALL BE VACUUM TIGHT AND HAVE A HELIUM LEAK RATE OF 1×10^{-9} CC PER SECOND. VACUUM LEAK TEST IS REQUIRED. MINIMUM OF 10 TIMES PUMP DOWN, HOLD AND RELEASE, TO BE SURE WELDS ARE STRONG ENOUGH TO HOLD VACUUM.
2. USE APPROPRIATE PROCEDURE SPECIFIED ON ASM METAL HANDBOOK, WELDING AND BRAZING, FOR WELDING ASTM A-36 STEEL PLATE TO STAINLESS TUBE, TYPE 304.
3. PAINT ALL EXTERIOR SURFACE OF CARBON STEEL FLANGE :
   a. CLEAN AND DEGREASE.
   b. RUST-OLEUM 9301 PRIMER (WHITE)
   c. FINISH RUST-OLEUM 9322 (PALE BLUE)

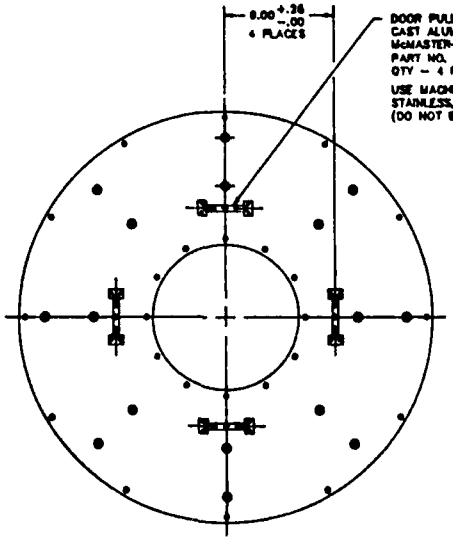
   FLANGE CONTACT SURFACE SHALL BE FREE OF PAINT.
4. ALL MACHINE SURFACE FINISH SHALL BE 63 OR BETTER.
5. ALL PARTS SHALL BE FREE OF DIRT AND GREASE.
6. BREAK OFF ALL SHARP EDGES AND CORNERS.
7. PROVIDE THE FOLLOWING :
   A. PARKER O-RING BUNA N 2-377 QTY - 10 REQD
   B. PARKER O-RING BUNA N 2-456 QTY - 1 REQD
   C. STAINLESS 18-8, SOCKET HD CAP SCREW 1/4-20 UNC X .75 LG QTY - 100 REQD
   D. STAINLESS 18-8, HEX HD CAP SCREW 3/8-16 UNC X 1.50 LG QTY - 12 REQD
8. ALL FLANGES AND PORT SURFACES HAVE TO BE MACHINED AFTER WELDING.

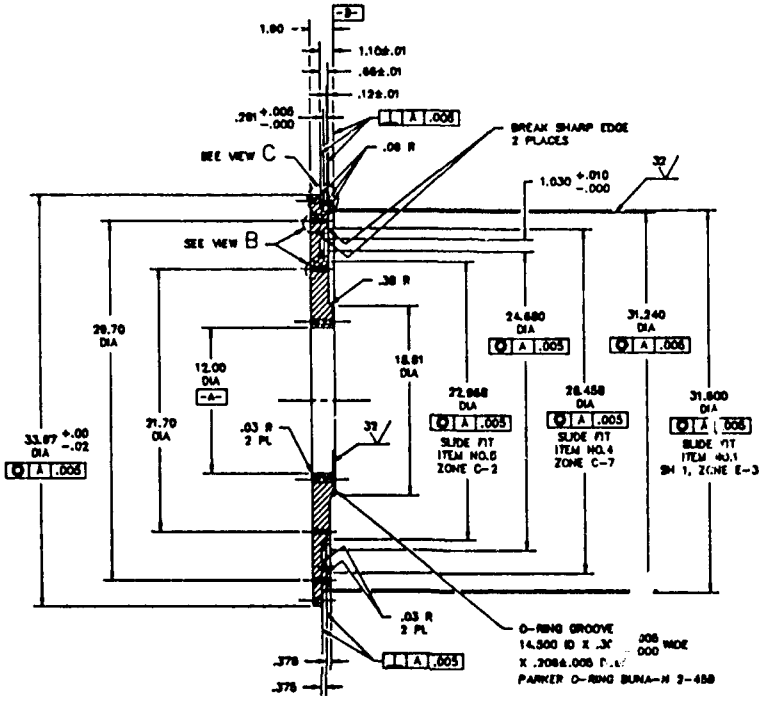
12

Viewing port housing

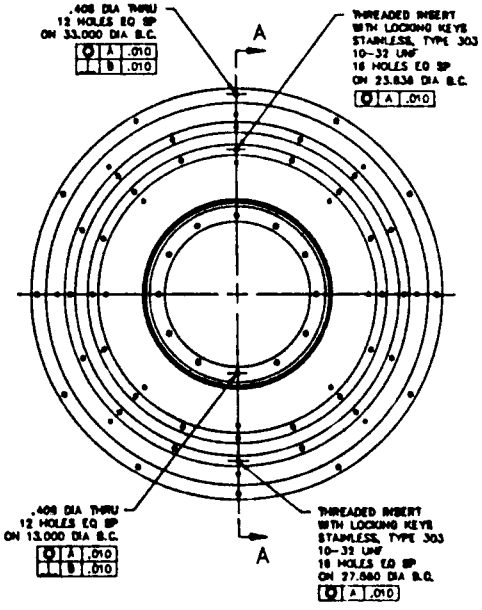
VIEWING PORT HOUSING
COAXIAL H.V. GENERATOR

91-0028

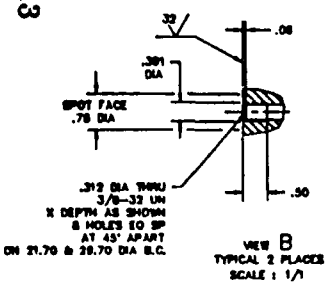




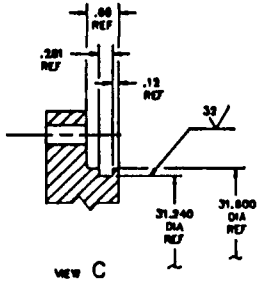
SECTION A-A
DOOR PULL NOT SHOWN ON THIS SECTION



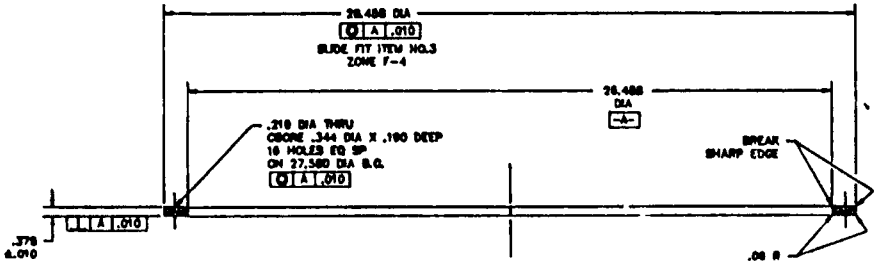
ITEM NO. 3
MATERIAL : AL ALY PLATE, 6061-T6
QUANTITY - 1 REQD



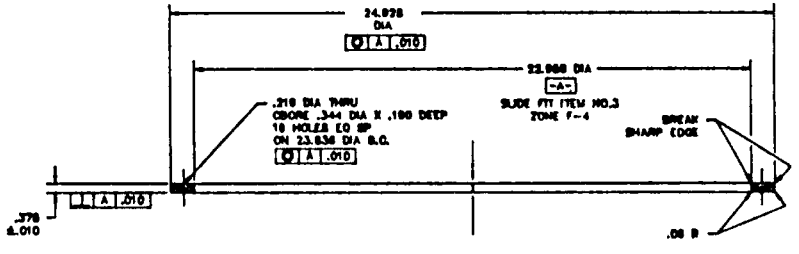
VIEW B
TYPICAL 2 PLACES
SCALE : 1/1



VIEW C
SCALE : 1/1



ITEM NO. 4
MATERIAL : AL ALY PLATE, 6061-T6
QUANTITY - 1 REQD
SCALE : 1/2

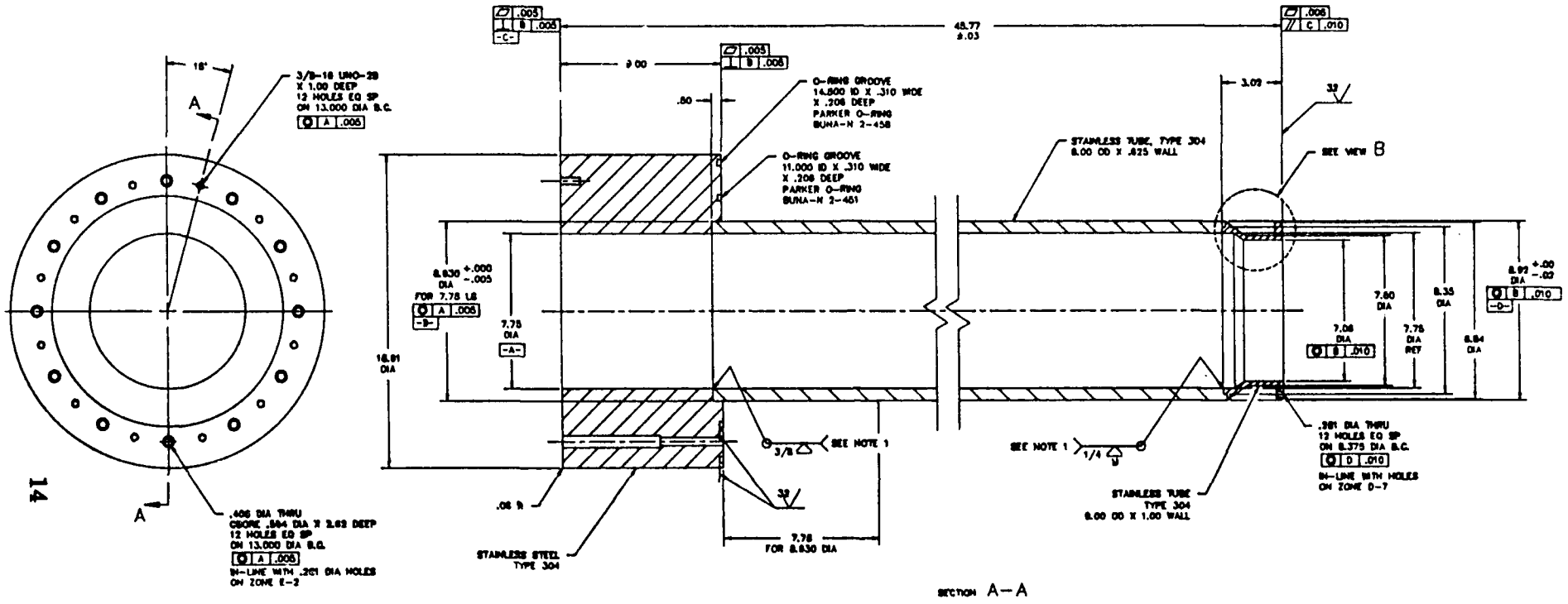


ITEM NO. 5
MATERIAL : AL ALY PLATE, 6061-T6
QUANTITY - 1 REQD
SCALE : 1/2

Viewing port housing

VIEWING PORT HOUSING
COAXIAL H.V. GENERATOR

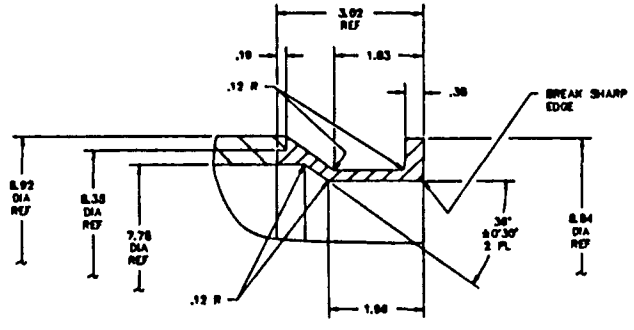
01-0028



SECTION A–A

ITEM NO. 1

QUANTITY – 1 REQD



VIEW B

SCALE : 1/1

NOTES :

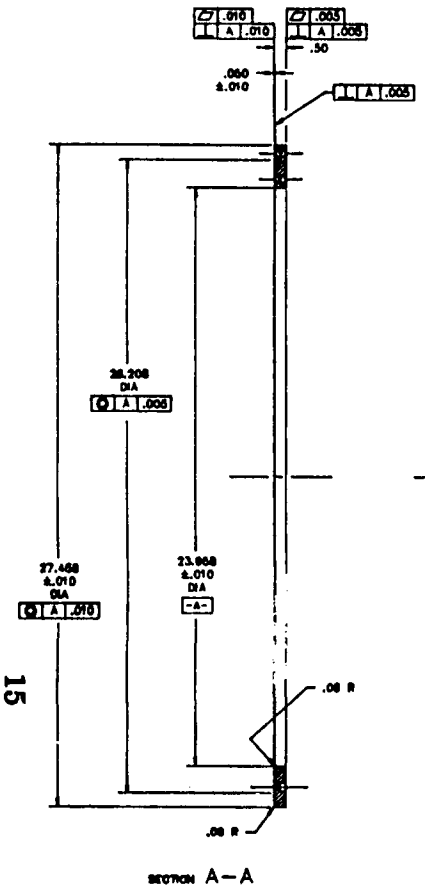
1. ALL WELDS SHALL BE VACUUM TIGHT AND HAVE A HELIUM LEAK RATE OF 1×10^{-6} CC PER SECOND. VACUUM LEAK TEST IS REQUIRED. MINIMUM OF 10 TIMES PUMP DOWN, HOLD AND RELEASE, TO BE SURE WELDS ARE STRONG ENOUGH TO HOLD VACUUM.
2. ALL MACHINE SURFACE FINISH SHALL BE 63 OR BETTER.
3. BREAK OFF ALL SHARP EDGES AND CORNERS.
4. ALL PARTS SHALL BE FREE OF DIRT AND GREASE.
5. ALL FLANGES AND CONTACT SURFACES HAVE TO BE MACHINED AFTER WELDING.

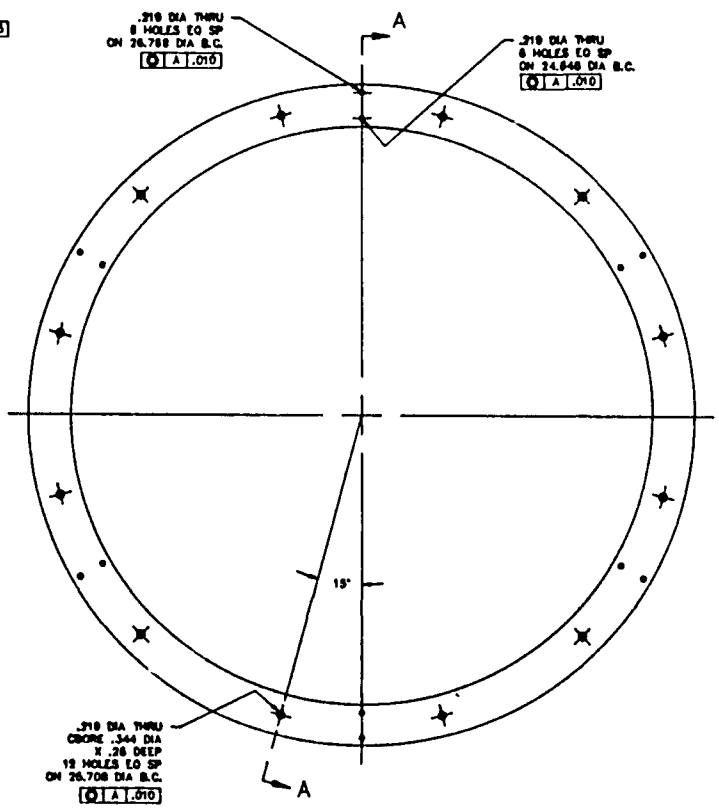
14

Cathode sub-assembly

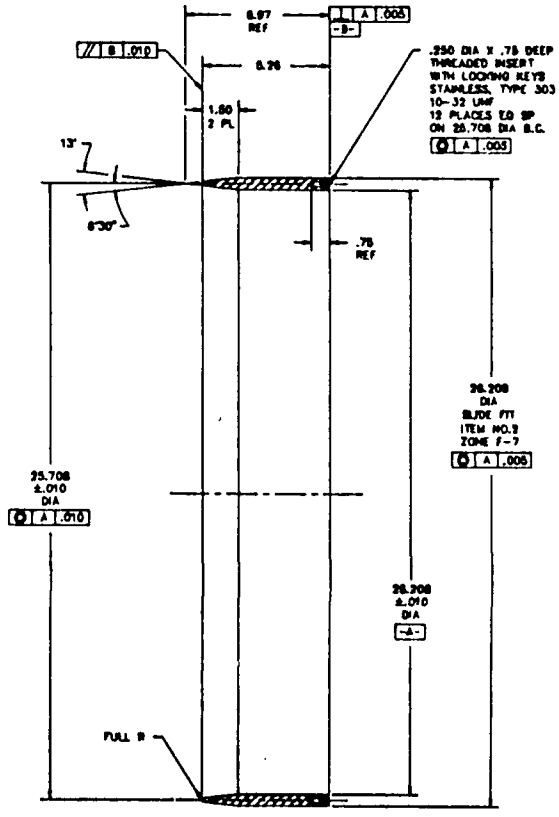
CATHODE SUB-ASSY
COAXIAL H.V. GENERATOR

91-0029

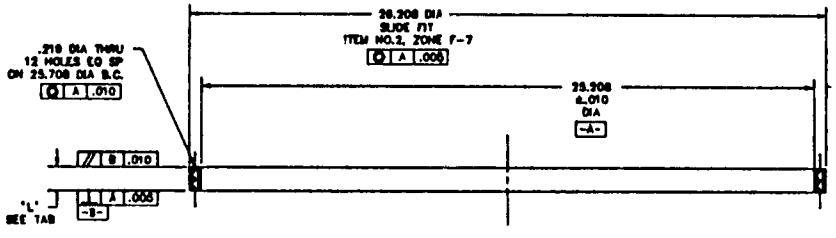




ITEM NO. 2
MATERIAL : AL ALY PLATE 6061–T6
QUANTITY – 1 REQD



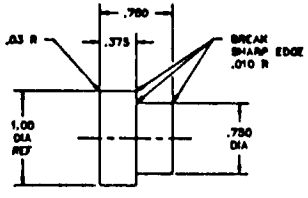
ITEM NO. 3
MATERIAL : AL ALY 6061–T6
ROLLED TUBE
QUANTITY – 1 REQD



TABULATION

DASH NO	QTY	'L'
–1	1	.50
–2	1	.75
–3	1	1.00

ITEM NO. 4
MATERIAL : AL ALY 6061–T6
ROLLED TUBE



ITEM NO. 5
SCALE : 1/1

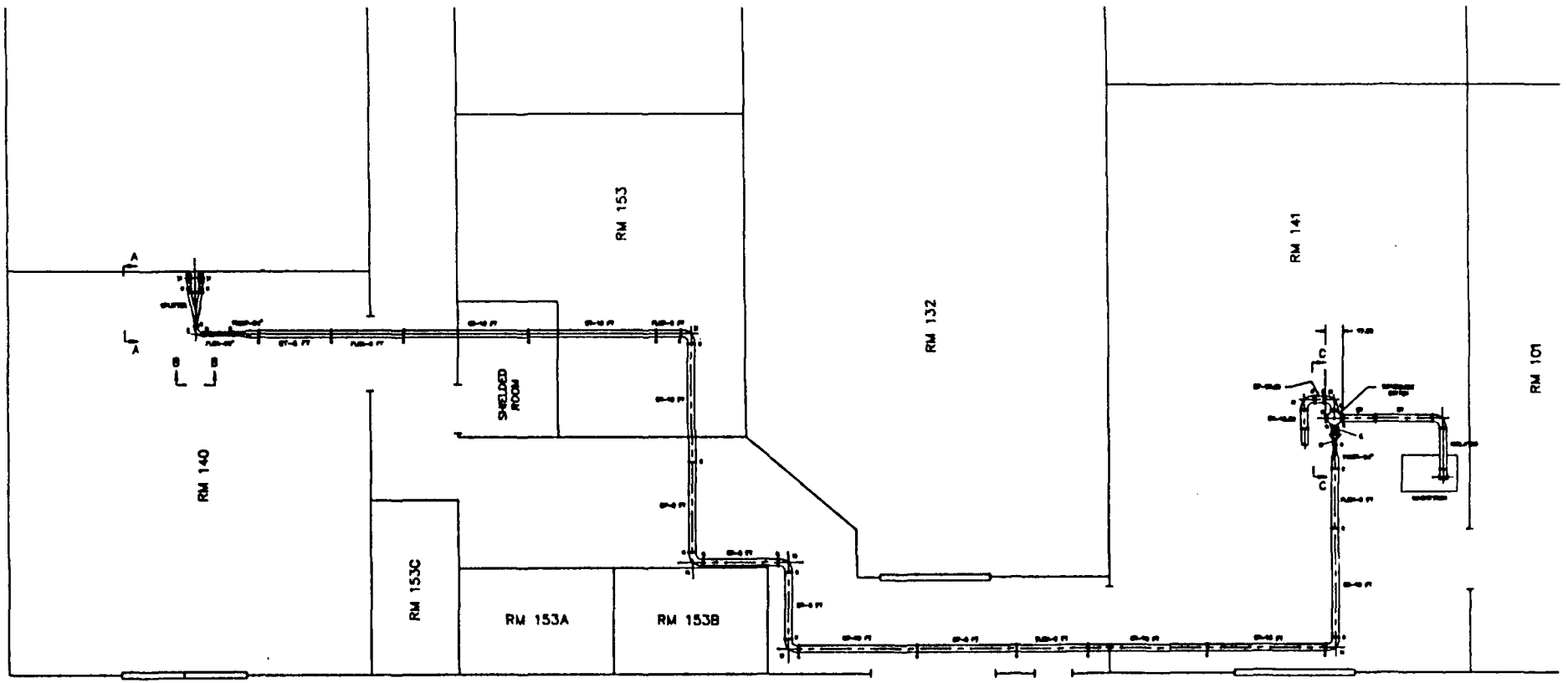
DASH NO.	QTY	MATERIAL
–1	400	LUCITE BAR 1.00 DIA
–2	80	* GRAPHITE BAR, GRADE DFP–1, 1.00 DIA X 1 FT LG

* POCO GRAPHITE INC.
DECATUR, TX 76234
TEL. # 817–627–2121

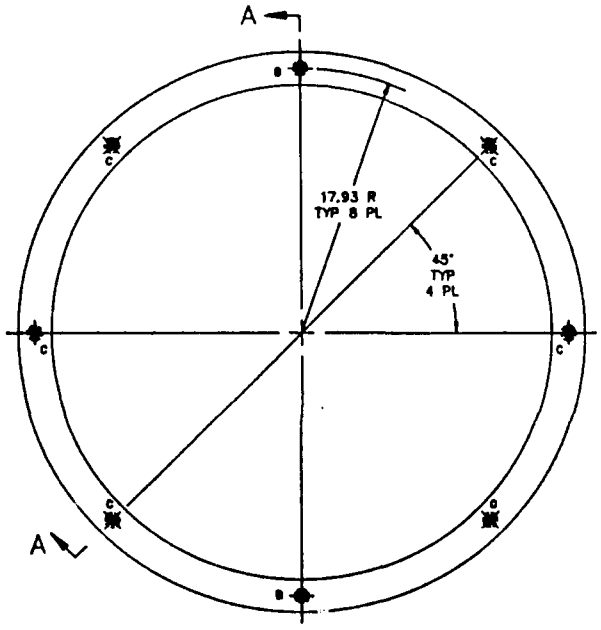
CATHODE SUB–ASSY
COAXIAL H.V. GENERATOR

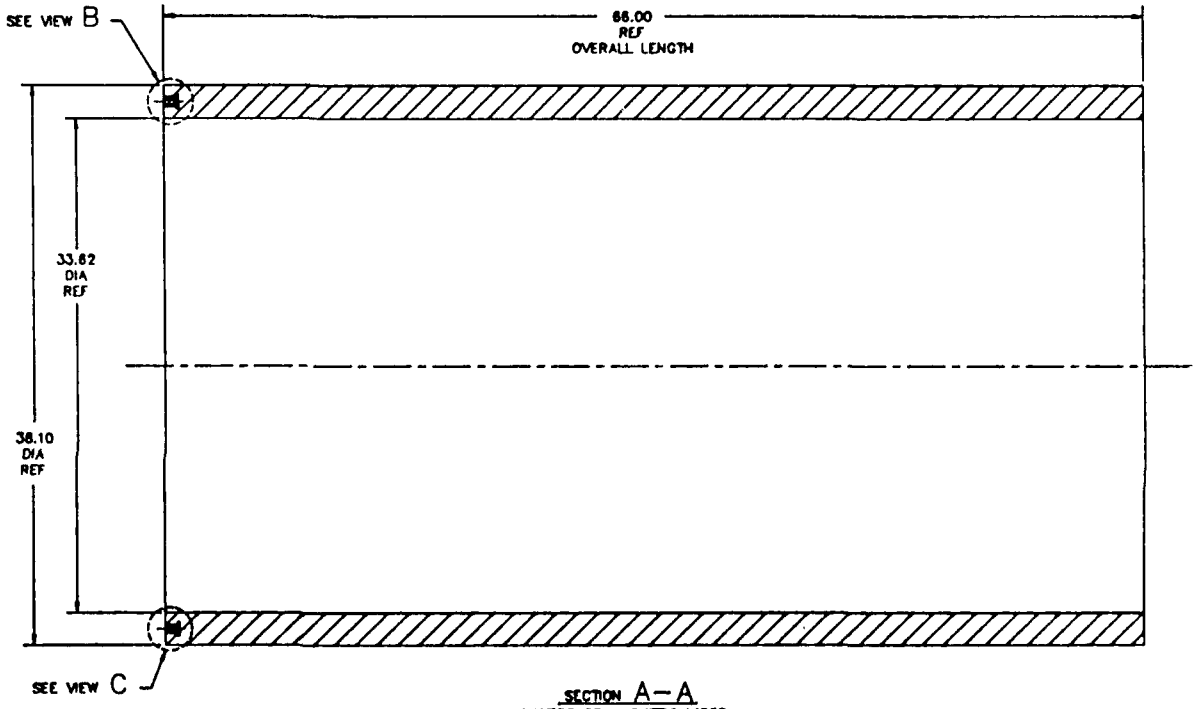
91–0029

Cathode sub-assembly

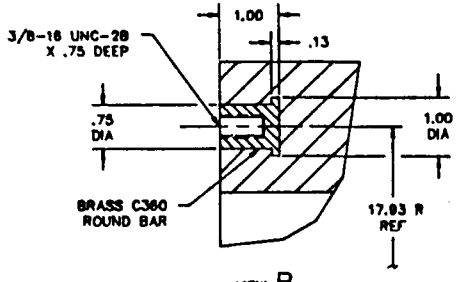


L–band waveguide transmission line



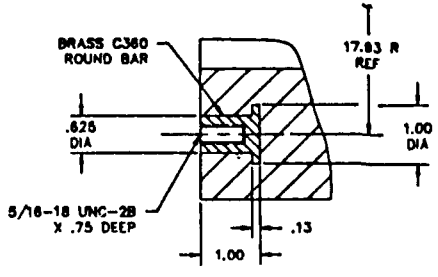


SECTION A–A
LAYERS OF MAGNETIC WIRES
NOT SHOWN ON THIS SECTION
SEE SHEET 2



VIEW B

2 PLACES AT 180° APART
FOR ELECTRICAL TERMINAL "IN" & "OUT"
FOR THE DESIGN CONSTRUCTION OF THE BRASS BLOCK
ANYTHING SIMILAR OR EQUIVALENT IS PERMISSIBLE
CONNECTIONS TO WIRE DESIGN CONSTRUCTION
TO BE DETERMINED BY MANUFACTURER
DIMENSIONS SHOWN ARE REFERENCE ONLY
SCALE : 1/1



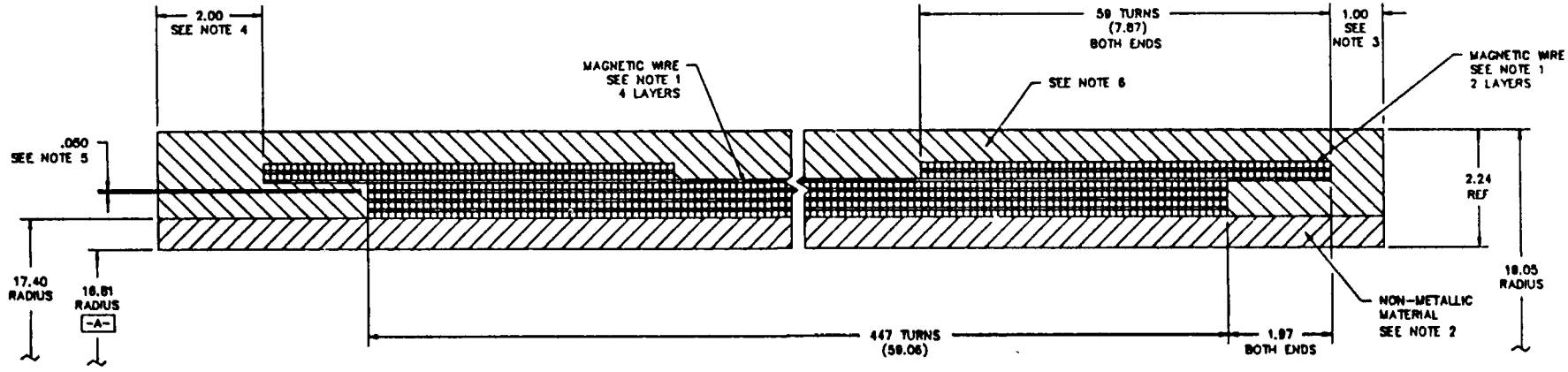
VIEW C

5/16-18 UNC HOLES MARK 'C'
8 PLACES AT 45° AS SHOWN
WILL BE USED FOR MECHANICAL PURPOSE
FOR THE DESIGN CONSTRUCTION OF THE BRASS BLOCK
ANYTHING SIMILAR OR EQUIVALENT IS PERMISSIBLE
SCALE : 1/1

OUTER INDUCTIVE COIL
(LARGE)

91-0051

Outer inductive coil (large)



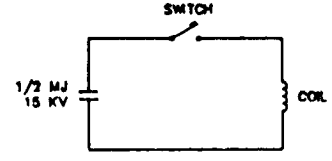
NOTES :

1. SQUARE INSULATED MAGNET WIRE, GAGE #8, 0.1285" X 0.1285" BARE WIRE, INSULATION CAPABLE TO WITHSTAND TEMPERATURES IN EXCESS OF 100 DEG. CENTIGRADE AND HOLD OFF VOLTAGES OF 20 VOLTS BETWEEN ADJACENT TURNS.
2. MAGNET WIRE SHALL BE WOUND ON A NON-METALLIC TUBE, CAPABLE TO WITHSTAND THE WEIGHT OF THE WIRE. THE INSIDE AND OUTSIDE DIAMETERS OF THE TUBE SHALL BE CONCENTRIC TO WITHIN ±0.010".
3. LENGTH OF 1.00" OF INSULATING AND NON-METALLIC MATERIAL.
4. LENGTH OF 2.00" OF INSULATING AND NON-METALLIC MATERIAL.
5. EACH LAYER OF WIRE SHALL BE CONCENTRIC WITH DATUM A TO WITHIN ±0.005" ALONG THE ENTIRE LENGTH OF THE COIL. AFTER BEING WOUND, EACH LAYER OF MAGNET WIRE WILL BE WETTED WITH EPOXY AND COVERED WITH INSULATING PAPER. THE PAPER WILL EXTEND AXIALLY 0.5" BEYOND THE MAGNET WIRE LAYER (TO PREVENT SURFACE FLASHOVER), AND IT WILL OVERLAP ON ITSELF BY AT LEAST 1.0". SUBSEQUENTLY, THE PAPER WILL BE COVERED BY STRANDED FIBERGLASS WET-LAID WITH EPOXY. AFTER BEING CURED AND HARDENED THE FIBERGLASS INSULATION SHALL BE MACHINED SO THAT THE TOTAL INSULATION THICKNESS BETWEEN LAYERS IS 0.050" AND THE MACHINED SURFACE IS CONCENTRIC WITH DATUM A TO WITHIN ±0.005" ALONG THE ENTIRE LENGTH OF THE COIL.
6. INSULATING AND NON-METALLIC MATERIAL.
7. ALL LAYERS OF THE MAGNET WIRE SHALL BE WOUND IN THE SAME DIRECTION. FOR EXAMPLE, IF STARTED CLOCKWISE, ALL LAYERS WILL BE CLOCKWISE. THE HELIX OF THE WINDINGS SHALL BE OPPOSITE FROM LAYER TO LAYER. ALL WIRE CONNECTIONS SHALL BE IN SERIES, CONNECTING AN END OF ONE LAYER TO THE BEGINNING OF THE NEXT ONE.
8. MAGNET WIRE USED IN EACH LAYER SHALL BE CONTINUOUS, NO JOINT IS PERMISSIBLE. CONNECTIONS BETWEEN LAYERS WILL BE DONE BY BRAZING.
9. INSIDE DIAMETER TOLERANCE ±0.060", OUTSIDE DIAMETER TOLERANCE ±0.090".
10. THE ENDS OF THE COIL SHALL BE VACUUM IMPREGNATED WITH EPOXY IN SUCH A WAY THAT THE EPOXY COMPLETELY FILLS THE VOIDS CREATED BY THE INSULATING PAPER EXTENDING BETWEEN THE WIRE LAYERS.

SPECIFICATIONS AND REQUIREMENTS :

1. OPERATING VOLTAGE OF 15 kV ON TERMINALS.
2. PULSE DURATION – .200 MILLISECONDS OR LARGER.
3. MECHANICALLY ABLE TO WITHSTAND MAGNETIC FIELDS OF UP TO 15 kGAUSS.
4. MINIMUM LIFETIME OF 10,000 SHOTS, AS PER CONDITIONS STATED IN 1, 2, & 3. ONE SHOT EVERY 5 MINUTES, AND NOT MORE THAN 50 SHOTS PER DAY.

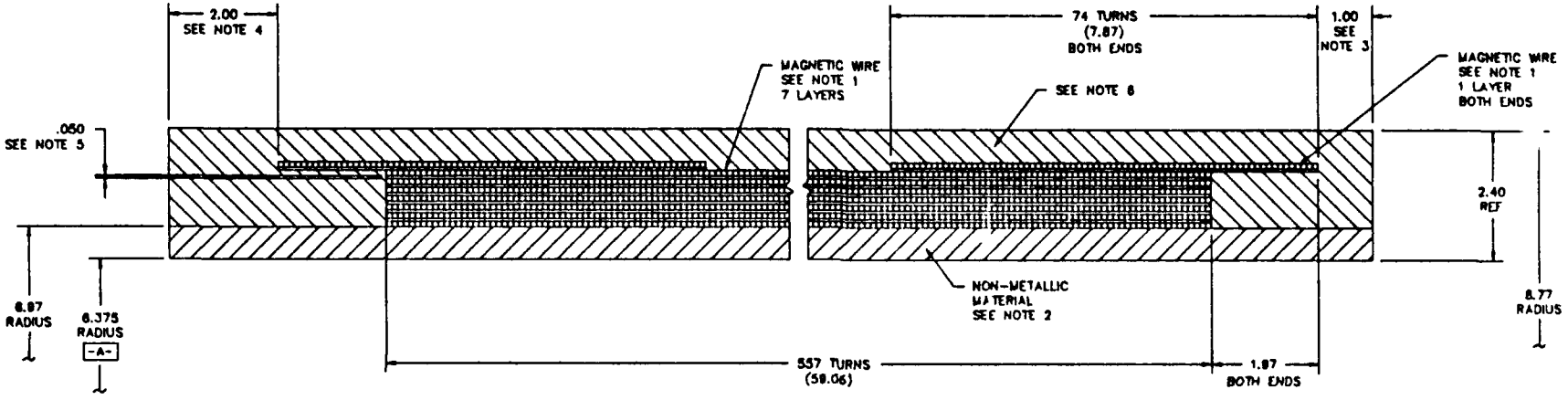
SCHEMATIC DIAGRAM



OUTER INDUCTIVE COIL
(LARGE)

91-0051

Outer inductive coil (large)



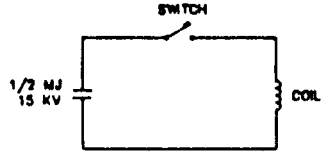
NOTES :

1. SQUARE INSULATED MAGNET WIRE, GAGE #10, 0.102" X 0.102" BARE WIRE, INSULATION CAPABLE TO WITHSTAND TEMPERATURES IN EXCESS OF 100 DEG. CENTIGRADE AND HOLD OFF VOLTAGES OF 20 VOLTS BETWEEN ADJACENT TURNS.
2. MAGNET WIRE SHALL BE WOUND ON A NON-METALLIC TUBE, CAPABLE TO WITHSTAND THE WEIGHT OF THE WIRE. THE INSIDE AND OUTSIDE DIAMETERS OF THE TUBE SHALL BE CONCENTRIC TO WITHIN ±0.010".
3. LENGTH OF 1.00" OF INSULATING AND NON-METALLIC MATERIAL.
4. LENGTH OF 2.00" OF INSULATING AND NON-METALLIC MATERIAL.
5. EACH LAYER OF WIRE SHALL BE CONCENTRIC WITH DATUM A TO WITHIN ±0.005" ALONG THE ENTIRE LENGTH OF THE COIL. AFTER BEING WOUND, EACH LAYER OF MAGNET WIRE WILL BE WETTED WITH EPOXY AND COVERED WITH INSULATING PAPER. THE PAPER WILL EXTEND AXIALLY 0.5" BEYOND THE MAGNET WIRE LAYER (TO PREVENT SURFACE FLASHOVER), AND IT WILL OVERLAP ON ITSELF BY AT LEAST 1.0". SUBSEQUENTLY, THE PAPER WILL BE COVERED BY STRANDED FIBERGLASS WET-LAID WITH EPOXY. AFTER BEING CURED AND HARDENED THE FIBERGLASS INSULATION SHALL BE MACHINED SO THAT THE TOTAL INSULATION THICKNESS BETWEEN LAYERS IS 0.050" AND THE MACHINED SURFACE IS CONCENTRIC WITH DATUM A TO WITHIN ±0.005" ALONG THE ENTIRE LENGTH OF THE COIL.
6. INSULATING AND NON-METALLIC MATERIAL.
7. ALL LAYERS OF THE MAGNET WIRE SHALL BE WOUND IN THE SAME DIRECTION. FOR EXAMPLE, IF STARTED CLOCKWISE, ALL LAYERS WILL BE CLOCKWISE. THE HELIX OF THE WINDINGS SHALL BE OPPOSITE FROM LAYER TO LAYER. ALL WIRE CONNECTIONS SHALL BE IN SERIES, CONNECTING AN END OF ONE LAYER TO THE BEGINNING OF THE NEXT ONE.
8. MAGNET WIRE USED IN EACH LAYER SHALL BE CONTINUOUS, NO JOINT IS PERMISSIBLE. CONNECTIONS BETWEEN LAYERS WILL BE DONE BY BRAZING.
9. INSIDE DIAMETER TOLERANCE ±0.060", OUTSIDE DIAMETER TOLERANCE ±0.080".
10. THE ENDS OF THE COIL SHALL BE VACUUM IMPREGNATED WITH EPOXY IN SUCH A WAY THAT THE EPOXY COMPLETELY FILLS THE VOIDS CREATED BY THE INSULATING PAPER EXTENDING BETWEEN THE WIRE LAYERS.

SPECIFICATIONS AND REQUIREMENTS :

1. OPERATING VOLTAGE OF 15 kV ON TERMINALS.
2. PULSE DURATION - 200 MILLISECONDS OR LARGER.
3. M'CHANICALLY ABLE TO WITHSTAND MAGNETIC FIELDS OF UP TO 15 kGAUSS.
4. MINIMUM LIFETIME OF 10,000 SHOTS, AS PER CONDITIONS STATED IN 1, 2, & 3, ONE SHOT EVERY 6 MINUTES, AND NOT MORE THAN 50 SHOTS PER DAY.

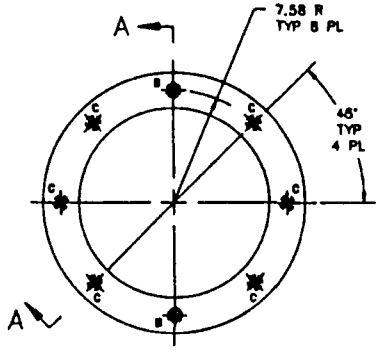
SCHEMATIC DIAGRAM

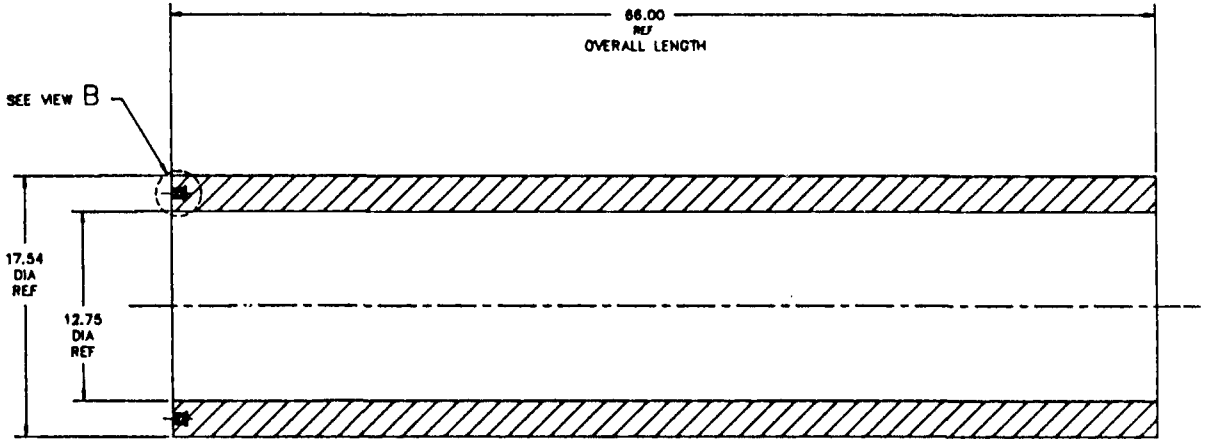


INNER INDUCTIVE COIL
(SMALL)

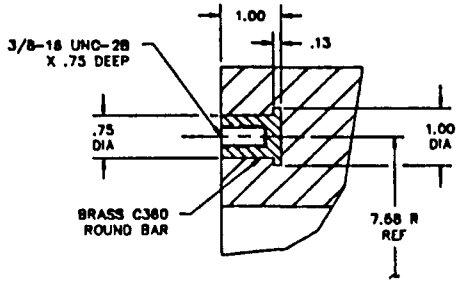
91-0050

Inner inductive coil (small)



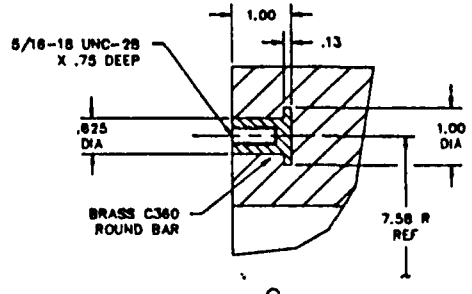


SECTION A–A
LAYERS OF MAGNETIC WIRES
NOT SHOWN ON THIS SECTION
SEE SHEET 2



VIEW B

2 PLACES AT 180° APART
FOR ELECTRICAL TERMINAL "IN" & "OUT"
FOR THE DESIGN CONSTRUCTION OF THE BRASS BLOCK
ANYTHING SIMILAR OR EQUIVALENT IS PERMISSIBLE
CONNECTIONS TO WIRE DESIGN CONSTRUCTION
TO BE DETERMINED BY MANUFACTURER
DIMENSIONS SHOWN ARE REFERENCE ONLY
SCALE : 1/1



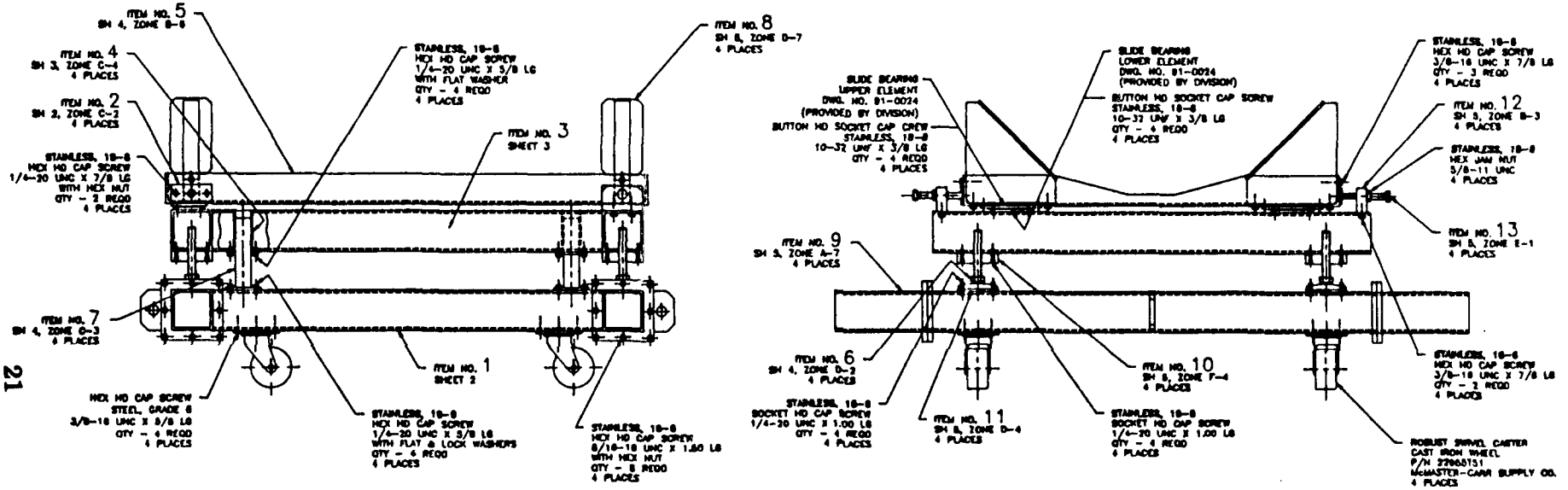
VIEW C

5/16-18 UNC HOLES MARK 'C'
8 PLACES AT 45° AS SHOWN
WILL BE USED FOR MECHANICAL PURPOSE
FOR THE DESIGN CONSTRUCTION OF THE BRASS BLOCK
ANYTHING SIMILAR OR EQUIVALENT IS PERMISSIBLE
SCALE : 1/1

INNER INDUCTIVE COIL
(SMALL)

91-0050

Inner inductive coil (small)



NOTES :

1. GRIND OFF ALL SHARP EDGES AND CORNERS.
2. ALL PARTS SHALL BE FREE OF DIRT AND GREASE.
3. PRE-ASSEMBLE ALL PARTS TO BE SURE THAT IT FITS ACCORDING TO THE ASSEMBLY AS SHOWN.
4. PROVIDE THE FOLLOWING :
   A. ALL SCREWS AND NUTS CALLED OUT ON THE FIELD OF THE DRAWING.
   B. ROBUST SWIVEL CASTER
      CAST IRON WHEELS
      1000 LBS CAPACITY
      P/N 2285S751
      QUANTITY - 4 REQD
      McMASTER-CARR SUPPLY CO.
      TEL. # 908-329-3200

Cart for inductive coil

CART FOR INDUCTIVE COIL	
	91-0025